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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	IR3-012
First Inventor	Jere F. Irwin
Title	Apparatus and Method for Conveying, Guiding, and Locating...
Express Mail Label No.	EL465688324

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: Assistant Commissioner for Patents
Box Patent Application
Washington, DC 20231

1. [X] Fee Transmittal Form (e.g., PTO/SB/17) in dupl.
   (Submit an original and a duplicate for fee processing)
2. [X] Applicant claims small entity status
   See 37 CFR 1.27.
3. [X] Specification [Total Pages 30] + title page
   (preferred arrangement set forth below)
   - Descriptive title of the invention
   - Cross Reference to Related Applications
   - Statement Regarding Fed sponsored R & D
   - Reference to sequence listing, a table, or a computer program listing appendix
   - Background of the Invention
   - Brief Summary of the Invention
   - Brief Description of the Drawings (if filed)
   - Detailed Description
   - Claim(s)
   - Abstract of the Disclosure
4. [X] Drawing(s) (35 U.S.C. 113) [Total Sheets 4] Figs. 1-4
5. Oath or Declaration [Total Pages]
   a. [ ] Newly executed (original or copy)
   b. [ ] Copy from a prior application (37 CFR 1.63 (d)) (for continuation/divisional with Box 17 completed)
      i. [ ] DELETION OF INVENTOR(S)
      Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).
6. [ ] Application Data Sheet. See 37 CFR 1.76
7. [ ] CD-ROM or CD-R in duplicate, large table or Computer Program (Appendix)
8. Nucleotide and/or Amino Acid Sequence Submission (if applicable, all necessary)
   a. [ ] Computer Readable Form (CRF)
   b. Specification Sequence Listing on:
      i. [ ] CD-ROM or CD-R (2 copies); or
      ii. [ ] paper
   c. [ ] Statements verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

9. [ ] Assignment Papers (cover sheet & document(s))
10. [ ] 37 CFR 3.73(b) Statement (when there is an assignee) [ ] Power of Attorney
11. [ ] English Translation Document (if applicable)
12. [ ] Information Disclosure Statement (IDS)/PTO-1449 [ ] Copies of IDS Citations
13. [ ] Preliminary Amendment
14. [X] Return Receipt Postcard (MPEP 503) (Should be specifically itemized)
15. [ ] Certified Copy of Priority Document(s) (if foreign priority is claimed)
16. [ ] Other: Check for $ 373.00

17. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below and in a preliminary amendment, or in an Application Data Sheet under 37 CFR 1.76:

[ ] Continuation [ ] Divisional [ ] Continuation-in-part (CIP) of prior application No.: ______ / ______

Prior application information Examiner ______ Group / Art Unit ______

For CONTINUATION OR DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 5b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

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JC925 U.S. PTO
09/686714
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FEE TRANSMITTAL for FY 2000

Patent fees are subject to annual revision.

TOTAL AMOUNT OF PAYMENT ($) 373.00

Complete if Known	
Application Number	
Filing Date	October 10, 2000
First Named Inventor	Jere F. Irwin
Examiner Name	
Group Art Unit	
Attorney Docket No.	IR3-012

METHOD OF PAYMENT (check one)

1. [X] The Commissioner is hereby authorized to charge indicated fees and credit any overpayments to:
   Deposit Account Number: 23-0925
   Deposit Account Name: Wells, St. John, et al.
   [X] Charge Any Additional Fee Required Under 37 CFR 1 16 and 1 17
   [X] Applicant claims small entity status See 37 CFR 1 27
2. [X] **Payment Enclosed:** [X] Check [ ] Credit card [ ] Money Order [ ] Other

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
101	690	201	345	Utility filing fee	355
106	310	206	155	Design filing fee	
107	480	207	240	Plant filing fee	
108	690	208	345	Reissue filing fee	
114	150	214	75	Provisional filing fee	

SUBTOTAL (1) ($) 355

2. EXTRA CLAIM FEES

		Extra Claims		Fee from below		Fee Paid
Total Claims	22	-20** =	2	X 9	=	18
Independent Claims	3	- 3** =	0	X 39	=	0
Multiple Dependent					=	

**or number previously paid, if greater, For Reissues, see below

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
103	18	203	9	Claims in excess of 20
102	78	202	39	Independent claims in excess of 3
104	260	204	130	Multiple dependent claim, if not paid
109	78	209	39	** Reissue independent claims over original patent
110	18	210	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($) 18

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
105	130	205	65	Surcharge - late filing fee or oath	
127	50	227	25	Surcharge - late provisional filing fee or cover sheet	
139	130	139	130	Non-English specification	
147	2,520	147	2,520	For filing a request for *ex parte* reexamination	
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	
113	1,840*	113	1,840*	Requesting publication of SIR after Examiner action	
115	110	215	55	Extension for reply within first month	
116	380	216	190	Extension for reply within second month	
117	870	217	435	Extension for reply within third month	
118	1,360	218	680	Extension for reply within fourth month	
128	1,850	228	925	Extension for reply within fifth month	
119	300	219	150	Notice of Appeal	
120	300	220	150	Filing a brief in support of an appeal	
121	260	221	130	Request for oral hearing	
138	1,510	138	1,510	Petition to institute a public use proceeding	
140	110	240	55	Petition to revive - unavoidable	
141	1,210	241	605	Petition to revive - unintentional	
142	1,210	242	605	Utility issue fee (or reissue)	
143	430	243	215	Design issue fee	
144	580	244	290	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	50	123	50	Petitions related to provisional applications	
126	240	126	240	Submission of Information Disclosure Stmt	
581	40	581	40	Recording each patent assignment per property (times number of properties)	
146	690	246	345	Filing a submission after final rejection (37 CFR § 1.129(a))	
149	690	249	345	For each additional invention to be examined (37 CFR § 1 129(b))	
179	690	279	345	Request for Continued Examination (RCE)	
169	900	169	900	Request for expedited examination of a design application	

Other fee (specify) _____

* Reduced by Basic Filing Fee Paid

SUBTOTAL (3) ($)

SUBMITTED BY				Complete (if applicable)	
Name (Print/Type)	Keith D. Orzelak	Registration No. (Attorney/Agent)	37,144	Telephone	509/624-4276
Signature	Keith D. Orzelak			Date	10/10/00

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EL465688324

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION FOR LETTERS PATENT

* * * * *

APPARATUS AND METHOD FOR CONVEYING, GUIDING, AND LOCATING A THERMOFORMABLE WEB

* * * * *

INVENTOR

Jere F. Irwin

ATTORNEY'S DOCKET NO. IR3-012

APPARATUS AND METHOD FOR CONVEYING, GUIDING, AND LOCATING A THERMOFORMABLE WEB

TECHNICAL FIELD

This invention pertains to an apparatus and method for handling a thermoformed sheet or web of plastic or foam material containing thermoformed thin-walled articles when separating the articles from the web. More particularly, this invention relates to a trim press article handling apparatus such as a conveyor having a treadle in the form of a web and article conveying, guiding, and locating device.

BACKGROUND OF THE INVENTION

Various devices are known for trimming thin-walled articles from sheets of thermoformed plastic material. The trimming or severing of such articles from a continuous sheet of thermoformable plastic and/or foam material has long been known in the art. Additionally, sheet guides and mechanical treadles are known for moving the sheet and articles for intermittent severing between coacting punches and dies of a trim press.

US Patent No. 4,173,161 discloses a mechanical trim press that includes a mechanical treadle having feed fingers mounted on the treadle. The feed fingers comprise a mechanical linkage that interacts with projecting integral tabs formed in the sheet to advance the sheet

to a die in step-by-step movement that is mechanically synchronized with the stroke of the punch. The treadle also includes opposed pairs of vertical guide strips between each article. Each guide strip is carried by a spacer that is mounted onto a cross frame member of the treadle. Opposed pairs of guide strips, provided between each adjacent pair of formed articles in the sheet, are spaced apart slightly from each other by a distance slightly greater than the thickness of the sheet passing therebetween. However, such close spacing coupled with the use of guide strips between every adjacent pair of articles results in increased frictional forces which tends to result in mis-feeding and jamming of the treadle, particularly when running the treadle at relatively high product feed rates.

SUMMARY OF THE INVENTION

A treadle device is provided for conveying, guiding, and locating web-supported articles or products during a web processing operation. More particularly, a treadle assembly guides web-supported articles into a trim press prior to and while severing the articles from the web. Such treadle device provides accurate location of articles while moving the web while and reducing frictional forces generated between the treadle and web which otherwise result in an increased occurrence of mis-feeds and misalignment of the web and articles, particularly during relatively high speed trim operations. An additional degree of accuracy

is also provided during such severing operation over that previously provided via use of accurate high speed conveying, guiding, and locating techniques. Additionally, feedback controlled operation is maintained to drive a servo pick and servo helper of a web feed delivery device associated with the treadle and trim press.

According to one aspect, a trim press article handling apparatus includes a frame, a punch, a die, and a treadle. The punch is carried by the frame. The die is carried by the frame and cooperates in relative movement with the punch to sever articles from a web. The treadle is carried for movement relative to the die. The treadle includes a web guide member, a primary guide strip spaced from the guide member slightly greater than a thickness of the web, a secondary guide strip spaced from the guide member at least four thicknesses of the web and spaced apart from the primary guide strip, and an article detector carried by at least one of the primary guide strip and the secondary guide strip. The article detector is operative to detect position of an article in the web by detecting the position of a protuberance in the web as the protuberance is conveyed between the primary guide strip and the secondary guide strip.

According to another aspect, an article conveying, guiding, and locating device includes a treadle, a web conveyor, an article detector, and a controller. The treadle includes a web guide plate, and a guide strip spaced slightly greater than a thickness of the web from the guide

plate. The web conveyor has a servo pick assembly and a servo helper assembly driven by a servo motor, and is configured to move a web of articles wherein the servo pick assembly is carried by the treadle. The article detector is carried by the treadle and is operative to detect location of an article in the web during movement of the web. The controller communicates with the drive motors and the article detector and is operative to controllably regulate and synchronize operation of the servo pick assembly and the servo helper assembly in response to detected location of the article.

According to yet another aspect, a method is provided for delivering web-supported articles between dies and punches of a trim press, including: providing a treadle having an article detector; while moving the web and articles, guiding the web and articles along the web and between a pair of articles in a row extending transverse to a travel path direction; detecting location of an article in the web using the article detector; in response to detecting the location of the article, controllably moving the web to position the article between a corresponding punch and die of the trim press.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention are described below with reference to the following accompanying drawings.

Fig. 1 is a vertical side view of a thermoforming machine trim press having a treadle conveying, guiding, and locating device embodying one aspect of the invention.

Fig. 2 is a simplified partial perspective view of the treadle of Fig. 1 and illustrates an article sensing device provided by the treadle.

Fig. 3 is a simplified sectional view taken generally along line 3-3 of Fig. 2 but including the trim press punch plate and die plate of Fig. 1 and further showing the control system and servo pick conveyor.

Fig. 4 is an enlarged, simplified sectional view of the primary guide member and web guide plate taken generally along line 3-3 of Fig. 2 and including a web containing articles.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

This disclosure of the invention is submitted in furtherance of the constitutional purposes of the U.S. Patent Laws "to promote the progress of science and useful arts" (Article 1, Section 8).

Reference will now be made to a preferred embodiment of Applicant's invention. One exemplary implementation is described below and depicted with reference to the drawings comprising an article conveying, guiding, and locating device and method for aligning articles within a web of thermoformable material for a severing operation. While the invention is described by way of a preferred embodiment, it is understood that the description is not intended to limit the invention

to this embodiment, but is intended to cover alternatives, equivalents, and modifications such as are included within the scope of the appended claims.

In an effort to prevent obscuring the invention at hand, only details germane to implementing the invention will be described in great detail, with presently understood peripheral details being incorporated by reference, as needed, as being presently understood in the art.

A preferred embodiment of Applicant's invention is shown on a thermoforming machine trim press having a treadle system that is generally designated with reference numeral 10 in Figure 1. More particularly, treadle system 10 is provided on a trim press 12 to accurately convey, guide, and locate articles 14 formed within a sheet, or web, 16 of thermoformable material during an article trim operation that severs articles 14 from web 16. Treadle system 10 is operative to intermittently convey and align articles 14 so as to successively sever rows of such articles 14 from the web 16.

A control system 18 of treadle system 10 choreographs operation of trim press 10 acting in unison with a servo motor driven conveyor 20 that includes a servo pick assembly 60 and a servo helper assembly 62. Conveyor 20 moves web 16 in which individual articles, or products, 14 have previously been formed using a thermoforming machine (not shown). In operation, web 14 is driven in intermittent motion using control system 18 and conveyor 20 to successively feed individual rows of articles

14 into trim press 12 where the articles 14 are severed from web 16. During closure of trim press 12, treadle 10 aids in accurately positioning articles 14 with respect to punch and die members 22 and 24 just prior to severing articles 14 from web 16.

Further details of one exemplary trim press similar to trim press 12, but configured in a vertical orientation are disclosed in Applicant's co-pending U.S. Patent Application Serial No. 09/576,219, entitled "Article Stacking Device, Trim Press Article Accumulator, and Method of Stacking Thermoformed Articles", naming Jere F. Irwin as inventor. Such U.S. Patent Application Serial No. 09/576,219 is herein incorporated by reference. Trim press 12, as depicted herein, is a modified version of Applicant's commercially available trim press "Model 28NT Trim Press", sold by Irwin Research and Development, of Yakima, Washington. The modifications entail adding the novel control system 18, conveyor assembly 20, and treadle system 10.

In order to improve the speed and accuracy with which articles 14 are severed from web 16 by trim press 12, treadle 10 is provided on trim press 12 incorporating desired features of Applicant's invention. Treadle 10 provides highly accurate article conveying, guiding, and locating when delivering web-supported articles between punches 22 and dies 24 of trim press 12.

Trim press 12 includes a movable platen 26, a stationary platen 28, a punch plate 30, and a die plate 32. Punch plate 30 is carried for

movement by movable platen 26, whereas die plate 32 is fixedly carried by stationary platen 28. However, it is understood that platen 28 and die plate 32 can also be movably supported for operation according to an alternative construction.

As shown in Figure 1, movable platen 26 is carried for horizontal reciprocation by crank arm assemblies 34-37. Details of one exemplary thermoforming machine suitable for incorporating treadle 10 and having such crank arm assemblies are shown in U.S. Patent Application Serial No. 08/691,856, now U.S. Patent No. 6,067,886, entitled "Machine Trim Press Having Counterbalance Features", and naming the inventor as Jere F. Irwin. Such U.S. Patent No. 6,067,886 is herein incorporated by reference.

An electric servo motor 31 drives crank arm assemblies 34-37 via a transfer case assembly 33 including a pair of connected transfer cases and a respective pair of rotating drive shafts 39, 41 similar to those disclosed in U.S. Patent No. 6,067,886, previously incorporated by reference.

Each crank arm assembly 34-37 comprises a throw arm 38 and a platen connecting rod 40, wherein arm 38 and rod 40 cooperate to form a kinematic linkage that drives a dedicated corner of platen 26 for horizontal, guided reciprocation. Additionally, two cylindrical, stationary guide posts (not shown) are rigidly carried by a frame 42 to support platen 26 for movement in an axial, horizontal direction. Optionally,

four guide posts can be configured to support platen 26 with two corresponding bronze bushings. The use of platen guide posts is understood in the art. Accordingly, such guide posts have been omitted from the figures in order to simplify the drawing and to prevent obscuring the invention at hand.

Additionally, a pair of stationary, cylindrical guide posts 44, 46 are rigidly supported by frame 42 to guide horizontal, reciprocating movement of treadle 10 relative to frame 42 and stationary platen 28. Bronze bushings 48 and 50-51 on treadle 10 are affixed to a frame 52 of treadle 10, and are configured to slide along guide posts 44, 46, respectively.

Stationary guide members 54 and 56, in the form of pairs of edge guide tracks and central guide tracks, form a self-feeding canopy 49 that guides web 16 and articles 14. More particularly, guide members 54 and 56 guide and move web 16 and articles 14 from a thermoforming machine (not shown), positioned upstream of trim press 12, downwardly into treadle 10 and between punch plate 30 and die plate 32 for severing articles 14 from web 16 therebetween.

Web conveyor assembly 20 moves web 16 and articles 14 along guide members 54 and 56 and through treadle 10. Web conveyor 20 comprises a servo pick assembly 60 and a servo helper assembly 62. Servo pick assembly 60 is carried by treadle 10, whereas servo helper assembly 62 is carried by guide member 54. Accordingly, servo pick

assembly 60 is carried for movement relative to stationary servo helper assembly 62.

As shown in Figure 1, web conveyor assembly 20 is illustrated in simplified form. More particularly, servo pick assembly 60 and servo helper assembly 62 are each depicted as a drive wheel assembly 64, 66, wherein each includes a servo motor (not shown) that is controllably actuated via a control system 18 to impart intermittent motion that feeds web 16 into trim press 12.

Servo pick assembly 60 and servo helper assembly 62, according to one construction, each include a Siemens servo motor Model Part No. 1FT5062-1AC71-4FA0, commercially available in the United States from Siemens Energy & Automation, of Atlanta, Georgia. Additionally, the servo motors for servo pick assembly 60 and servo helper assembly 62 each further includes a rotary encoder which is used in conjunction with the servo motor as a feedback signal to detect motion of drive wheels 72 and 78 in order to directly measure the amount of feed imparted by server helper assembly 62 relative to the feed of servo pick assembly 60. Accordingly, the servo helper assembly is synchronized in relation to the speed of the servo pick assembly.

According to prior art techniques, a servo pick assembly was utilized with a helper assembly having a variable speed motor. The variable speed motor was regulated so as to deliver a distance of web at least as much as that which is moved by the servo pick assembly.

An accumulation region was provided along guide member 54 to accumulate any excess web which is overfed by the helper assembly, wherein the helper assembly is driven by the variable speed motor which is run at a speed that delivers a web equal to or greater in quantity than that delivered by the servo pick assembly. Hence, the accumulation of web and articles occurs along the guide member. However, the buildup of excess sheet there along has a tendency to bounce the sheet and articles around, which can cause misalignment problems and cause a reduction in the maximum operating speed for the conveyor. Accordingly, synchronization of a servo helper assembly with a servo pick assembly leads to increased product throughput rates. Such result is realized because the motor on the servo helper assembly can duplicate a nearly identical motion as the motor on the servo pick assembly since both motors comprise servo motors.

Additionally, a photo proximity switch 112 is carried by guide member 56, beneath one edge of web 16 for detecting the proximity of web 16 in relation to guide member 56. More particularly, switch 112 comprises a Model No. E51-Q25FN6FF100Q sensor, otherwise referred to as an Easy-Easy-Beam Q25 Series sensor, sold commercially by Banner Engineering Corporation of Minneapolis, Minnesota. Such a photo proximity switch has a focal range that monitors the proximity of web 16. When the web is within a focal point range of approximately four inches, a digital output is generated. When the focal point exceeds the

approximately four-inch range, a different digital value is generated and delivered to control system 18. Accordingly, control system 18 monitors the proximity of web 16 relative to guide member 56 of canopy 49. When a significant amount of detected separation occurs between web 16 and guide member 56, control system 18 reduces the operating speed of drive wheels 78 for servo helper assembly 62. Accordingly, the delivery speed of servo helper assembly 62 relative to servo pick assembly 60 is controllably regulated by control system 18 in response to the signal detected by photo proximity switch 112. Alternatively, it is understood that any of a number of other proximity switches can be utilized, such as proximity mode ultrasonic sensors, or optical detectors.

By controllably regulating the operating speed of drive wheels 78 relative to drive wheels 72, the accumulation of web 16 therebetween is substantially prevented.

Accordingly, the need for a substantial accumulation area along guide member 54 is eliminated. Furthermore, motion of the web and articles is monitored at treadle 10 via article detector 80 and control system 18. For cases where servo helper assembly 62 does not exactly mimic the delivery rate for the servo pick assembly 60 or when misalignment is detected or likely to occur, control system 18 briefly and quickly opens or raises follower wheel 76 away from drive wheel 78 using a pneumatic cylinder which raises each follower wheel 76 along opposite edges of web 16. Hence, opening of follower wheels 76 for a

very short period of time while trim press 12 is open enables realignment of the web and adjustment and spacing of the web between drive wheel assembly 64 and drive wheel assembly 66. For example, such opening in one case lasts 0.07 seconds. Such brief opening, actuated via pneumatic cylinders and control system 18, achieves minor corrections in the length and alignment of web positioned between drive wheel assemblies 64 and 66 which accounts for any minor variations in the amount of web delivered by servo pick assembly 60 and servo helper assembly 62. Accordingly, such correction is only implemented in response to monitoring of web and article delivery utilizing article detector 80 and/or switch 112. Alternatively, such correction can be implemented periodically, such as after every five trim press cycles.

According to one construction, optical beam 108 (see Fig. 3) detects locations of articles 14 by detecting the positioning of an article that interrupts beam 108. Alternatively, web 16 can include protuberances specifically designed to interrupt optical beam 108 and thermoformed into web 16 at a location known relative to articles 14. Accordingly, optical beam 108 can be utilized to detect such protuberances in order to locate the positioning of articles 14 relative to plate 100. Accordingly, articles 14 form one of a number of different types of protuberances within web 16 which are detected via optical (or light) beam 108.

As shown in Figure 1, drive wheel assembly 64 comprises two pairs of co-acting wheels that are provided along opposite side edges of web 16. An outermost wheel of each pair comprises a follower wheel 70 and an innermost wheel of each pair comprises a drive wheel 72. The pair of drive wheels 72 are driven by a common servo motor using a splined shaft (not shown) that extends between the drive wheels and drives each wheel using a splined drive wheel attached to each drive wheel 72 that attaches to the splined shaft via a correspondingly splined drive belt. Accordingly, each drive wheel 72 is actuated and driven by a common servo motor.

Accordingly, actuation of drive wheel assembly 64 via controller 68 is operative to intermittently deliver rows of articles 14 into trim press 12. Such rows of articles 14 are then severed as control circuitry 68 of central system 18 actuates a severing operation via trim press 10. Subsequently, a scrap web 74 is delivered from trim press 12 and ground into small pieces using a comminuting device (not shown) configured for grinding up scrap web 74 and positioned beneath trim press 12.

Similarly, drive wheel assembly 66 comprises two pairs of co-acting top and bottom wheels that are provided along opposite side edges of web 16. A topmost wheel of each pair comprises a follower wheel 76 and a bottom-most wheel of each pair comprises a drive wheel 78 that is actuated and driven by a servo motor. As was the case with driver assembly 64, drive wheels 78 of drive wheel assembly 66 are driven using

a common servo motor, a splined drive shaft, splined drive wheels, and a pair of correspondingly splined drive rollers attached to each drive wheel 78. Accordingly, actuation of drive wheel assembly 66 via controller 18 is operative to intermittently deliver rows of articles 14 into trim press 12 in cooperation with drive wheel assembly 64.

As shown in Figure 1, drive wheel assembly 64 comprises a dual servo motor driven roller feed assembly referred herein as servo pick assembly 60. According to one construction, follower wheels 70 and 76 are each formed from a high density polyethylene (HDPE) plastic material. Also according to one construction, drive wheels 72 and 78 are each formed from an anodized aluminum material having a knurled radial outer surface that coacts with web 16.

Additionally, web 16 is delivered through an oven and a thermoforming machine using a web conveyor, upstream of trim press 12. One exemplary detailed construction for a web conveyor is disclosed in U.S. Patent No. 5,806,745, herein incorporated by reference.

According to one construction, article registration is carried out by adjusting the operation of conveyor 20 using controller 18 in order to adjust the advancement and positioning of individual articles between punch plate 30 and die plate 32.

However, in some cases, it is very difficult to adjust the set-up and component positioning for a web conveyor in order to accurately and precisely deliver articles 14 between punch plate 30 and die plate 32.

Hence, article registration implemented solely using conveyor set-up and control does not always sever such articles in a sufficiently uniform and accurate manner. Furthermore, there are limitations to the accuracy with which a servo motor can drive conveyor assembly 20, and therefore, in the ability of such servo motors to accurately place articles 14 between punch plate 30 and die plate 32. Oftentimes, it is the case that articles 14 are off by several millimeters, which can produce an undesirable effect, particularly where article 14 is of a complicated shape, or article 14 comprises a foldable container having a hinge which requires a high degree of accuracy in forming and severing thereof in order to accurately place the hinge.

Accordingly, an article registration device (not shown) can alternatively be added to punch plate 30 and die plate 32 in order to provide an enhanced ability to accurately register articles 14 between punch plate 30 and die plate 32 when severing such articles 14 from web 16. One suitable article registration device is disclosed in Applicant's pending U.S. Patent Application Serial No. 09/575,783, entitled "Apparatus and Method Registering Articles During a Web Processing Operation", naming the inventor as Jere F. Irwin, and herein incorporated by reference.

After severing articles 14 from web 16, the scrap web is delivered into a comminuting apparatus (not shown) that is provided directly beneath punch plate 30 and die plate 32. Several different comminuting

apparatus are suitable for grinding up the resulting scrap web are disclosed in U.S. Patents Nos. 4,687,144; 5,836,527; 5,860,607; and 5,893,523, each herein incorporated by reference. Scrap web 74 is accordingly forwarded into such a recycling, pulverizing machine where the scrap web is shredded and then later recycled to form a new web of thermoformable plastic material.

Details of one exemplary thermoforming machine suitable for forming articles 14 within web 16 are disclosed in U.S. Patent No. 5,773,540. U.S. Patent No. 5,773,540 is herein incorporated by reference.

Control system 18 of Figure 1 comprises a controller having control circuitry 68 such as processing circuitry and memory. According to one construction, processing circuitry is provided by a central processing unit (CPU). According to another construction, processing circuitry is provided by a microcontroller which cooperates to form the controller. It is understood that memory is operative to store software subroutines that are retrieved and implemented on the processing circuitry in order to impart motion control functionality by way of controller 18 to trim press 12 and conveyor 20.

As shown in Figure 1, control system 18 is operative to generate control signals that direct operation of servo drive motor 31 that drives crank arm assemblies 34-37 and thereby imparts reciprocation to movable platen 26. Servo drive motor 31 comprises a highly accurate computerized servo motor and servo drive which can be accurately driven

by control system 18. In operation, servo drive motor 31 drives a gear box or transfer case 33 that imparts a rotary motion to each of crank arm assemblies 34-37. Furthermore, control system 18 is operative to deliver a control signal to the servo drive motors of servo pick assembly 60 and servo helper assembly 62 that advances article conveyor 20. Additionally, control system 18 receives an input signal from an article detector 80 provided on treadle 10 for detecting the location of articles being moved by treadle 10 into trim press 12.

As shown in Figures 1 and 3, treadle 10 is driven via a kinematic linkage 87 by movable platen 26, wherein movable platen 26 is driven via motor 31. Accordingly, kinematic linkage 87 causes frame 52 of treadle 10 to reciprocate back and forth in relation to the movement of movable platen 26, relative to stationary platen 28. Kinematic linkage 87 includes a rocker arm 89 which has a fixed rotatable pivot attached to frame 42.

As shown in Figure 2, a partial view of the treadle illustrates important components relating to Applicant's invention; namely, the frame of treadle 10 includes a pair of side plates 88 (only one illustrated herein) which are joined together by three tie rods 90. A primary guide member 82 is provided in proximate association with web guide plate, or web guide member, 100. A secondary guide member 84 is spaced substantially further apart from plate 100 than is primary guide member 82. Secondary guide member 84 is provided principally to serve as a

gross alignment structure which is received between adjacent rows of articles so as to grossly induce alignment of articles with web guide plate 100 relative to article apertures 102.

Primary guide member 82 and secondary guide member 84 each include an attachment plate 92 having a quick release adjustment collar 92 which includes a threaded, rotatable lock arm that enables clamping and unclamping of adjustment collar 92 along a central one of tire rods 90. In this manner, primary guide member 82 and secondary guide member 84 can be quickly and easily laterally adjusted in position relative to web guide plate 100 so as to accommodate changes to different die configurations.

Primary guide member 82 further comprises a clamp bar 96 affixed with fasteners to attachment plate 94, and further affixed to support a guide strip 98 that is nested in proximate relation relative to a surface of guide plate 100. According to one construction, a gap exists between guide strip 98 and web guide plate 100 somewhere in the range of 1-3.5 thicknesses of a web of material which is to be received and processed therebetween.

Secondary guide member 84 further comprises a clamp bar 96 carried by attachment plate 94 and further supporting a guide strip 198. Guide strip 198 is constructed so as to provide a substantially greater amount of clearance between guide strip 198 and web guide 100 than is provided between guide strip 98 and web guide plate 100. Accordingly,

guide strip 198 is spaced apart from plate 100 at least 3.5 thicknesses of a web which is to be received and processed therethrough. Preferably, web guide plate 100 is provided within a range of 3.5 to 10 thicknesses (or more) of a web of material. In this manner, delivery of a web and articles there along is principally guided by guide strip 98, and little or not contact occurs between guide strip 198 and such web during a processing operation.

Additionally, as shown in Figure 2, article detector 80 comprises an optical emitter 104 carried by attachment plate 94 of primary guide member 82 and a detector 106 carried by attachment plate 94 of secondary guide member 84. A light beam 108 is generated from emitter 104 and received at detector 106. The presentment of an article between primary guide member 82 and secondary guide member 84 causes interruption of light beam 108 which is detected at the control system 18 (of Fig. 1). Accordingly, the positioning of articles can be readily determined utilizing the control system and article detector 80 pursuant to Applicant's invention.

As additionally illustrated in Figure 2, servo pick assembly 60 comprises a pair of drive wheels 72 and follower wheels 70 along opposite edges of a web of material which is processed therebetween. Follower wheels 70 are retracted with each utilizing a knock lever mechanism 110 as treadle 10 is moved towards stationary platen 24 (of Fig. 1). Accordingly, drive wheels 72 and follower wheels 70 are

separated just prior to severing of an article so that further alignment can occur via coaction of the die surface and/or an alignment structure which further laterally positions articles relative to associated punches and dies of the trim press.

As shown in Figure 2, knock mechanism 110 comprises a kinematic linkage having a center pivot point and a lever arm at one end that contacts stationary platen 28 as treadle 10 is moved there against during a severing operation. The other end of mechanism 110 carries follower wheel 70. Such contact rotates follower wheel 70 away from drive wheel 72 so as to open up a gap therebetween, thereby releasing respective edges of the web to ensure further centering. Further centering relies on contour features of the individual punches 22 coacting in combination with the shape of in-molded articles in the web to laterally further align such articles relative to each respective punch and die, according to one construction.

Figure 3 illustrates in simplified form the arrangement of punch plate 30, web guide plate 100 (configured here as a stripper plate), and die plate 32. Controller 18 includes control circuitry 68 which is operative to control the servo motors which activate drive wheels 72. Follower wheels 70 are retractable in response to actuation of knock mechanism 110, illustrated in Figure 2.

As shown in Figure 3, guide strip 98 serves principally to guide web 16 and articles 14 against plate 100. In contrast, guide strip 198

is spaced a significant distance away from plate 100, and principally serves to support detector 106. However, guide strip 198 also serves to grossly retain web 14 into position along plate 100 in the event that web 16 becomes suddenly significantly misaligned. Accordingly, under normal operating conditions, guide strip 198 serves as the only principal guide for retaining web 16 in close proximity against web guide plate 100. Accordingly, frictional forces therebetween are significantly reduced. Furthermore, emitter 104 and detector 106 further serve to detect the location and positioning of articles 16 as they are delivered via drive wheel 72 (and associated servo motor). All such control is choreographed utilizing controller 18 as well as a feedback signal from detector 106.

As shown in Figure 3, punch plate 30 includes a plurality of punches 22, each supported on axially guided springs. The springs facilitate interdigitation and lateral alignment with appropriately configured articles 14, and compress and coact with punch plate 30 during final severing against die plate 32 through the holes within plate 100.

As shown in Figure 3, follower wheels 70 are caused to open (or retract) away from drive wheel 72 via action of knock lever mechanisms 110 (see Fig. 2). Such retraction further facilitates lateral alignment of web 16 and articles 14 relative to punches 22 and dies within die plate 32.

Also illustrated in Figure 3, guide strip 98 is shown in close proximity with web guide plate, or web guide member, 100. In contrast, guide strip 198 is shown spaced relatively far apart from plate 100.

Figure 4 illustrates an enlarged partial view corresponding with line 3-3 of Figure 2, the relative positioning of guide strip 98 of primary guide member 82 (see Fig. 2) relative to web guide plate 100. Guide strip 98 is provided in relatively close proximity with plate 100 so as to ensure alignment and positioning of web 16 (and articles 14) relative to articles apertures 102 in plate 100.

In compliance with the statute, the invention has been described in language more or less specific as to structural and methodical features. It is to be understood, however, that the invention is not limited to the specific features shown and described, since the means herein disclosed comprise preferred forms of putting the invention into effect. The invention is, therefore, claimed in any of its forms or modifications within the proper scope of the appended claims appropriately interpreted in accordance with the doctrine of equivalents.

CLAIMS:

1. A trim press article handling apparatus, comprising:

a frame;

a punch carried by the frame;

a die carried by the frame and cooperating in relative movement with the punch to sever articles from a web; and

a treadle carried for movement relative to the die, the treadle including a web guide member, a primary guide strip spaced from the guide member slightly greater than a thickness of the web, a secondary guide strip spaced from the guide member at least four thicknesses of the web and spaced apart from the primary guide strip, and an article detector carried by at least one of the primary guide strip and the secondary guide strip and operative to detect position of an article in the web by detecting the position of a protuberance in the web as the protuberance is conveyed between the primary guide strip and the secondary guide strip.

2. The article handling apparatus of claim 1 further comprising control circuitry communicating with the article detector and a drive motor operative to move the treadle, the control circuitry configured to receive an input signal from the article detector indicative of the position of a web-supported article relative to the punch and the die, and operative to control operation of the drive motor to synchronize

movement of the web-supported article via controlled motion of the treadle.

3. The article handling apparatus of claim 2 wherein the article detector comprises an optical emitter and a photodetector, one of the optical emitter and the photodetector provided on the primary guide strip and the other provided on the secondary guide strip spaced apart from the primary guide strip, wherein movement of a protuberance in the web between the optical emitter and the photodetector generates an output signal from the photodetector to the control circuitry indicative of the location of an article relative to the guide plate member.

4. The article handling apparatus of claim 2 wherein the article detector comprises an optical detector configured to generate a signal indicative of a change of state when a protuberance is detected with the optical detector.

5. The article handling apparatus of claim 2 wherein the protuberance is an article formed in web.

6. The article handling apparatus of claim 2 further comprising a drive wheel assembly for moving a web and articles, the drive wheel

assembly comprising a pair of roller feed assemblies provided on opposed edges of a web.

7. The article handling apparatus of claim 6 wherein each of the pair of roller feed assemblies provides a servo pick assembly having a servo motor controllably driven by the control circuitry.

8. The article handling apparatus of claim 1 wherein the primary guide strip and the web guide member depend in a vertical orientation from the treadle and the punch and the die are supported for relative movement in a horizontal direction.

9. The article handling apparatus of claim 7 wherein a topmost portion of the primary guide strip is flared away from the web guide member to accommodate entrance feeding of the web during movement between the treadle and the frame.

10. The article handling apparatus of claim 1 wherein the web guide member comprises a web guide plate providing a stripper plate for a trim press.

11. An article conveying, guiding, and locating device, comprising:

a treadle including a web guide plate, a guide strip spaced slightly greater than a thickness of the web from the guide plate;

a web conveyor having a servo pick assembly and a servo helper assembly driven by a servo motor, and configured to move a web of articles wherein the servo pick assembly is carried by the treadle;

an article detector carried by the treadle and operative to detect location of an article in the web during movement of the web; and

a controller communicating with the drive motors and the article detector and operative to controllably regulate and synchronize operation of the servo pick assembly and the servo helper assembly in response to detected location of the article.

12. The device of claim 11 wherein the motor for the servo pick assembly comprises a servo motor carried by the treadle.

13. The device of claim 11 wherein the article detector detects location of an article in the web by optically detecting the location of a protuberance in the web provided at a known location in the web relative to an article.

14. The device of claim 11 wherein the web conveyor comprises a pair of wheels provided along each edge of the web.

15. The device of claim 14 wherein each pair of the wheels comprises a drive wheel and a follower wheel coacting on opposite sides of the web, wherein the drive wheel is driven by a servo motor under control of the controller.

16. The device of claim 11 wherein one of the drive wheel and the follower wheel is selectively engaged and disengaged under control of the controller such that each pair of drive wheel and follower wheel is disengaged in anticipation of a severing operation to remove the articles from the web.

17. The device of claim 11 wherein the guide strip is spaced from the guide plate less than four thicknesses of the web.

18. The device of claim 11 further comprising a canopy, wherein the servo helper assembly is carried by the canopy and the servo pick assembly is carried by the treadle, and wherein a web detector is provided between the servo helper assembly and the servo pick assembly to detect proximity of the web relative to the canopy, and wherein the controller, in response to movement of web from the canopy, regulates operating speed of the motor for the servo helper assembly to adjust delivery speed at the servo helper assembly relative to delivery speed of the motor at the servo pick assembly.

19. A method for delivering web-supported articles between dies and punches of a trim press, comprising:

providing a treadle having an article detector;

while moving the web and articles, guiding the web and articles along the web and between a pair of articles in a row extending transverse to a travel path direction;

detecting location of an article in the web using the article detector; and

in response to detecting the location of the article, controllably moving the web to position the article between a corresponding punch and die of the trim press.

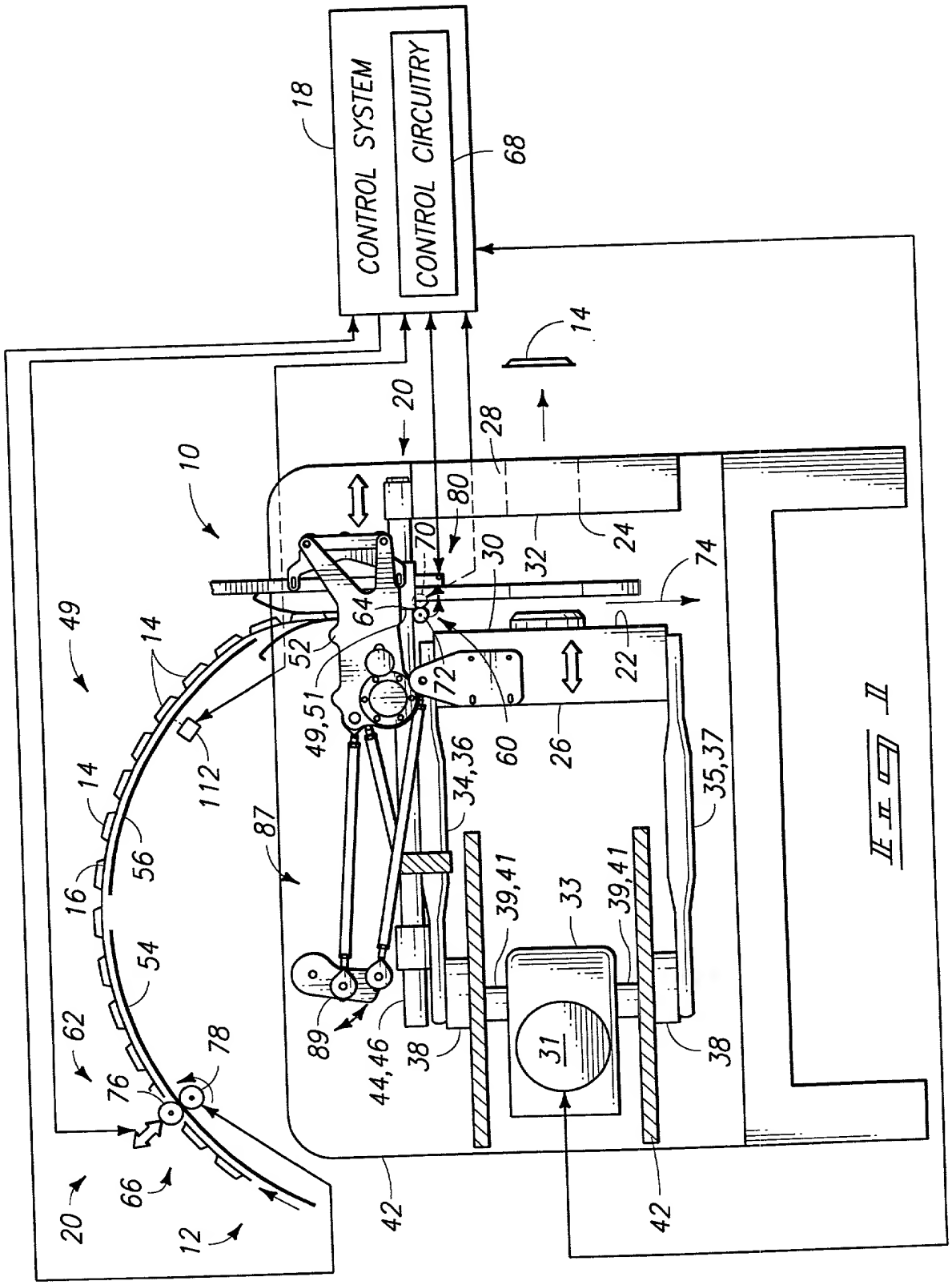
20. The method of claim 19 wherein the step of detecting location comprises optically detecting movement of an article relative to the article detector.

21. The method of claim 19 wherein the step of detecting location of an article comprises optically detecting a protuberance in the web.

22. The method of claim 19 wherein the protuberance is an article embedded in a web.

ABSTRACT OF THE DISCLOSURE

A trim press article handling apparatus includes a frame, a punch, a die, and a treadle. The punch is carried by the frame. The die is carried by the frame and cooperates in relative movement with the punch to sever articles from a web. The treadle is carried for movement relative to the die. The treadle includes a web guide member, a primary guide strip spaced from the guide member slightly greater than a thickness of the web, a secondary guide strip spaced from the guide member at least four thicknesses of the web and spaced apart from the primary guide strip, and an article detector carried by at least one of the primary guide strip and the secondary guide strip. The article detector is operative to detect position of an article in the web by detecting the position of a protuberance in the web as the protuberance is conveyed between the primary guide strip and the secondary guide strip. A method is also provided.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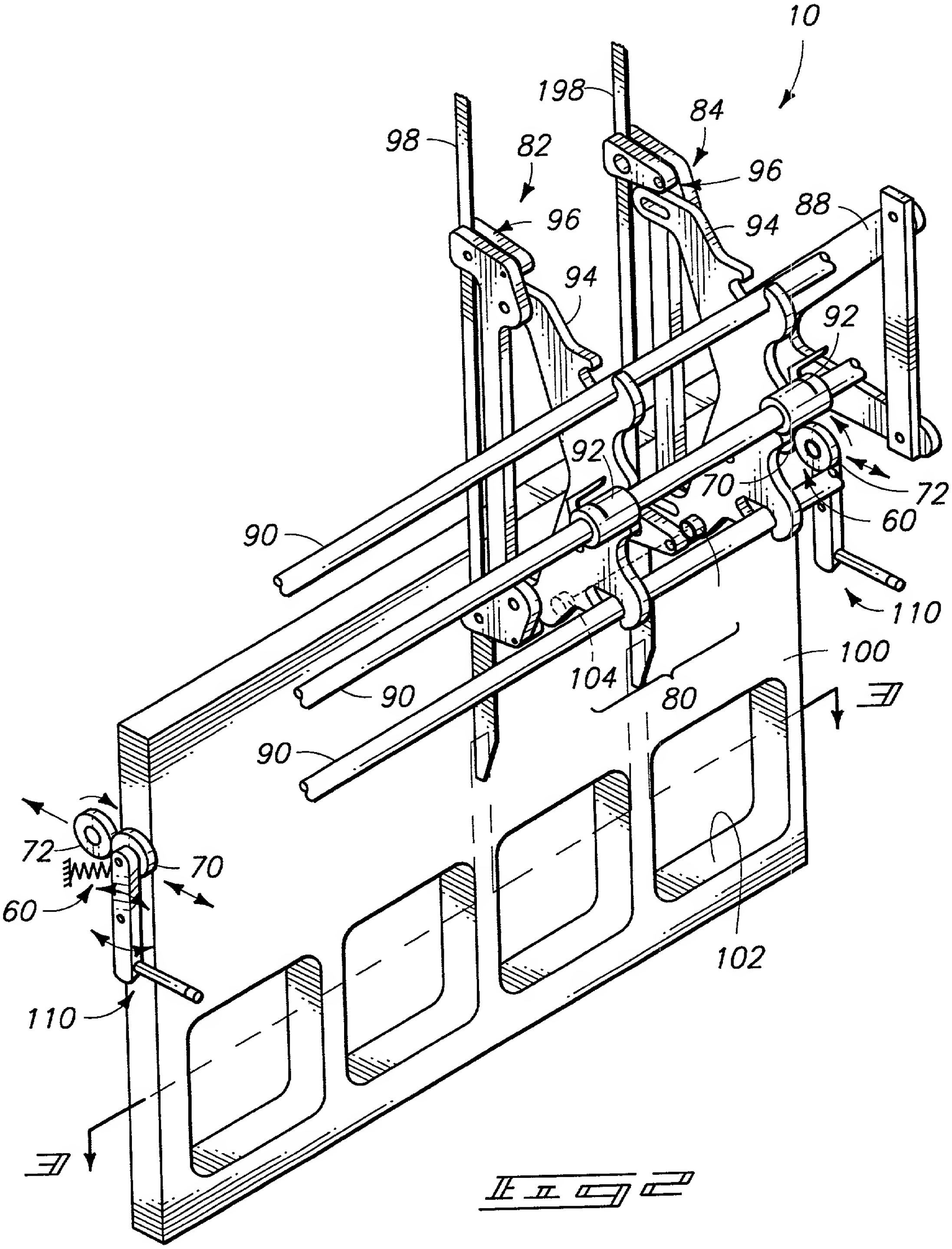
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FIG. 2

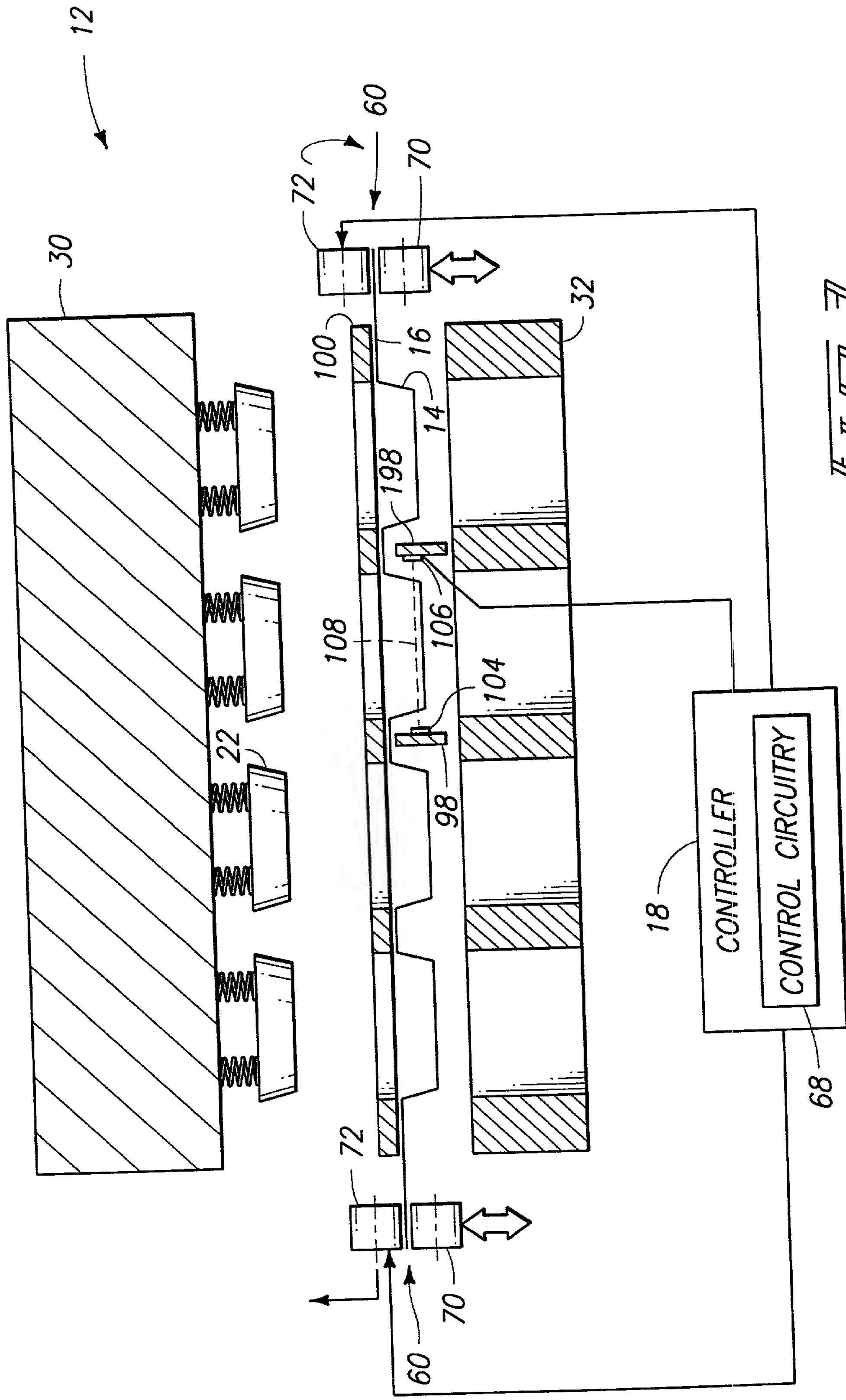
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FIG. 3

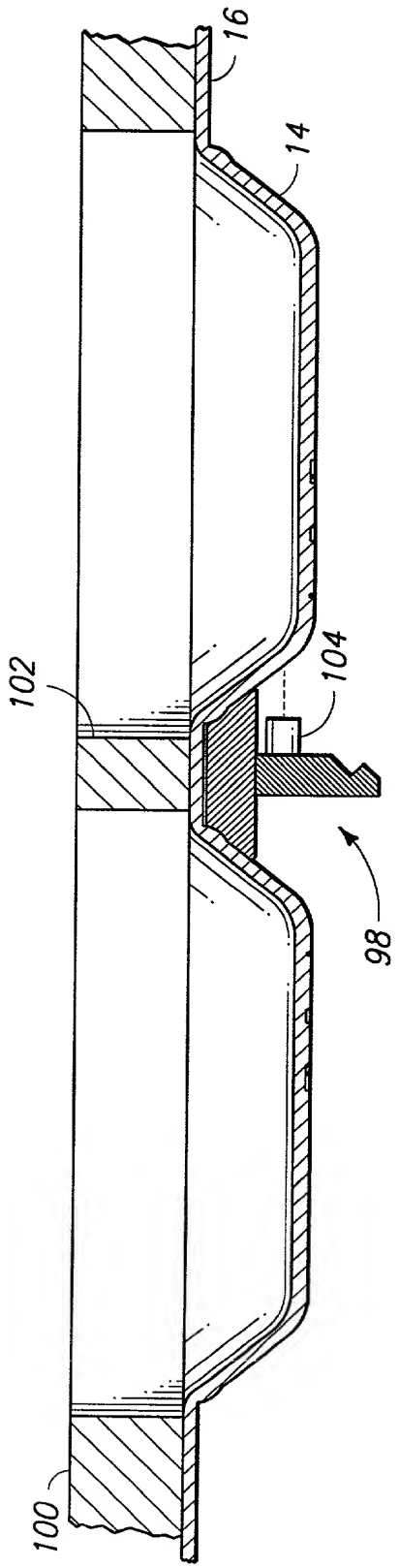

Fig 4